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INVESTIGATING STRATEGIES FOR IMPLEMENTING A SUSTAINABLE VEGETABLE FOOD CROP SYSTEM IN THREE AGRO ECOLOGICAL ZONES OF THE HUMID TROPICS AREA OF CAMEROON

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ABSTRACT Vegetable cultivation remains an essential component of local people's livelihoods. However, marked trend shifts in the varieties of vegetables due to large-scale commercial vegetable farming of exotic varieties in the broader market economy have resulted in the gradual disappearance of biodiversity involving vital species. The present study examined the situation of vegetable crop farming in three agro-ecological zones of Cameroon. Data were collected from a random sample of 235 respondents (177 farming households and 58 farm input wholesalers) by means of structured questionnaires. Vegetables were observed in both single and mixed cropping systems in all agro-ecological zones. Traditional vegetables such as African nightshade, waterleaf and Fluted pumpkin (okomobong) dominated in the Buea and Ebolowa areas. Over 51% of the vegetable farmers were women, although there was a rising population of men farming particularly in the Bafoussam area. Farmers remarked that pests and diseases followed by lack of good seeds were the main obstacles to vegetable farming. The study therefore points to the need for modification of the microenvironment and changing farming practices. Hence, strategies to fight poverty and malnutrition in Cameroon should include the promotion of traditional leafy and fruit vegetables by providing good quality seeds and variety screening trials.

Key Words: Traditional vegetables; Vegetable farming constraints; Vegetable seeds; Vegetable demand and preferences; Humid forest areas.

INTRODUCTION

Vegetables are the most economically efficient source of micronutrients, considering both per unit land required and per unit production cost (Ali, 2002; Abia et al., 2007; Tata et al., 2017). The diet of most Cameroonians is dominated by energy dense foods such as cassava, yam and plantain, which, in the absence of micro-nutrient rich vegetables and fruits, are considered incomplete for a balanced diet (Abia et al., 2007; Omara-Achong et al., 2012). The consumption of local vegetables serves as cost-effective and important sources of proteins, minerals, vitamins, and amino acids (Abia et al., 2007; Fon, 2011; Tata et al., 2017). In Cameroon, commonly grown exotic vegetables include tomato (*Lycopersicon esculentum*), hot and sweet pepper (*Capsicum annum*), onion (*Allium cepa*), and cabbage (*Brassica oleracea*). Commonly grown indigenous vegetables include:

amaranth (*Amaranthus* spp.), okra (*Abelmoschus esculentus*), African nightshade (*Solanum scabrum* and *S. villosum*), African eggplant (*Solanum aethiopicum*, *S. anguivi* and *S. macrocarpon*), jute mallow (*Chochorus* spp.), and bitterleaf (*Vernonia amygdalina*) (Abang et al., 2013; Asongwe et al., 2014; Tata et al., 2014). Most of these vegetables were grown all year-round with two to four rotations per plot per year (Temgoua et al., 2012; Asongwe et al., 2014; Abang et al., 2013).

Within the Cameroonian context, it is typical for every ethnic group to identify itself with a range of staple foods and vegetable crops that are of unique preference based on related cultural values and norms. In the *Moghamo* Clan (a major ethnic group of the inhabitants of the northwest region of Cameroon, made up of people from the Widikum tribe spanning some 22 villages) for example, there are over seven vegetable species and nine yam species that are used to prepare the preferred and delicacy foods of the clan. The *Oroko* clan (a major ethnic group of the inhabitants of the southwest region of Cameroon) uses 15 common vegetables in preparing their delicacies, with seven of them being traditional vegetables (Abia et al., 2007; Asongwe et al., 2014; Temgoua et al., 2012). Vegetable domestication has been an ongoing phenomenon in Cameroon for several decades. This has made it possible for consumers in all regions to have access to a large diversity of vegetables either through trade, wild gathering, or increased cultivation (Temgoua et al., 2012; Kenga et al., 2002; Tata et al., 2014). Some traditional species have now become widespread and appear to have become standard or globally important vegetables while some standard species have come to represent traditional vegetables by virtue of their long history of domestication (Kenga et al., 2002; Gockowski & Ndoumbe, 2004; Tata et al., 2014). However, in the course of the field survey, it was difficult to identify and ascertain which vegetables were more adaptable to particular agro-ecological zones in Cameroon given their long period of diverse domestication (Guarino, 2012). Furthermore, hunting and gathering of non-timber forest products (NTFP) from the forest was also another important means for food access (Sama et al., 1993; Omara-Achong et al., 2012). Since there is insufficient literature on the local diversity of indigenous or traditional and globally important vegetables within the agro-ecological zones, it was therefore important for the authors to analyse the different types of vegetables in these agro-ecological zones so as to understand what factors influenced their diversity while facilitating the continued existence of these vegetables (Weinberger & Msuya, 2004; Fon, 2011).

Vegetable farming in Cameroon has been highly intensive with comparatively high expenditures on labour, irrigation, fertilization, pesticides, mechanization, and pesticide application regimes that emphasize unsustainable practices (Abang et al., 2013). As well, vegetable farmers are often poor with limited access to land (German et al., 2009; Fon, 2011). Coupled with this was the short production cycle of many vegetable crops, their high perishability, poor marketing systems, and inadequate postharvest handling and processing technologies to preserve and conserve vegetable products, thereby constituting a great challenge to the country's effort to attain and maintain food self-sufficiency (Sama et al., 1993; Gebbers & Adamchuk, 2010). Consequently, it is necessary to develop strong

actions to reorient future intervention projects to promote small and medium sized vegetable enterprises, stimulate the marketing system and sustain a viable vegetable sector to boost the economy.

Despite the overwhelming role of vegetables in combating micronutrient malnutrition and the myriad of increasing problems that limit their productivity and accessibility, research on vegetable crops has dwindled since the early 1980's with very few researchers focusing on vegetable crops in Cameroon's national research system. This is apparent by the absence of allocations of vegetable crops in the national law on the seed sector in Cameroon (MINADER, 2010). Thus, present trends in vegetable crop distribution, labour, and gender roles in production and preferences for traditional vegetables within different agro-ecological zones are not necessarily known to researchers and policy makers. Therefore, it is hard for them to design actions to develop the vegetable supply sector. In Cameroon likewise, promotional activities for increased cultivation and use of vegetables for better nutrition in poor regions are needed. The objectives of this study therefore were to (i) investigate labour and gender distribution in vegetable cropping activity in different agro ecological regions, (ii) assess the distribution and diversity of vegetable crops within different regions of the humid forest zone, (iii) estimate farmer preferences for vegetable varieties per agro-ecological region, and (iv) analyze local constraints inhibiting vegetable cropping per agro-ecological region, and recommend strategies for a sustainable vegetable farming and cropping system in the humid tropical forest area of Cameroon.

MATERIALS AND METHODS

This study was carried out in twelve villages located in the three main agro-ecological regions of Buea, Ebolowa and Bafoussam in the humid tropics of Cameroon from November 2013 to January 2014. The Buea area is located around 4° 10' N & 9° 14' E, in the humid forest zone in the Southwest region. The area has an equatorial climate type with monomodal rainfall and constant high temperature of 26°C. The soils are dark fertile volcanic soils which favour the growth of staple crops such as plantains, cassava, cocoyam, yams, and vegetables like African nightshade and amaranth.

The Ebolowa study site is located around 2° 55' N & 11° 9' E in the humid forest zone with bimodal rainfall. The area has a Guinea-type climate (part Equatorial) with high humidity and rainfall (1,500–2,000 mm per year), with average temperature between 24–26°C. The red ferrallitic soils favor the growth of plantain, cassava, cocoyam, and few vegetables.

Bafoussam is located around 5° 28' N & 10° 25' E in the Western Highlands in the West Region at high elevations of 1,521 m. The Koppen-Geiger climate classification system classifies its climate as subtropical highland climate featuring moderate to high relative humidity of 25%, moderate rainfall, and temperatures averaging 22°C. Maize, rice, cassava, potato, beans and vegetables, e.g., cabbage and tomato, are the major food crops cultivated on a mixture of ferrallitic patches of red dirt soils. In the various agro-ecological zones, the agricul-

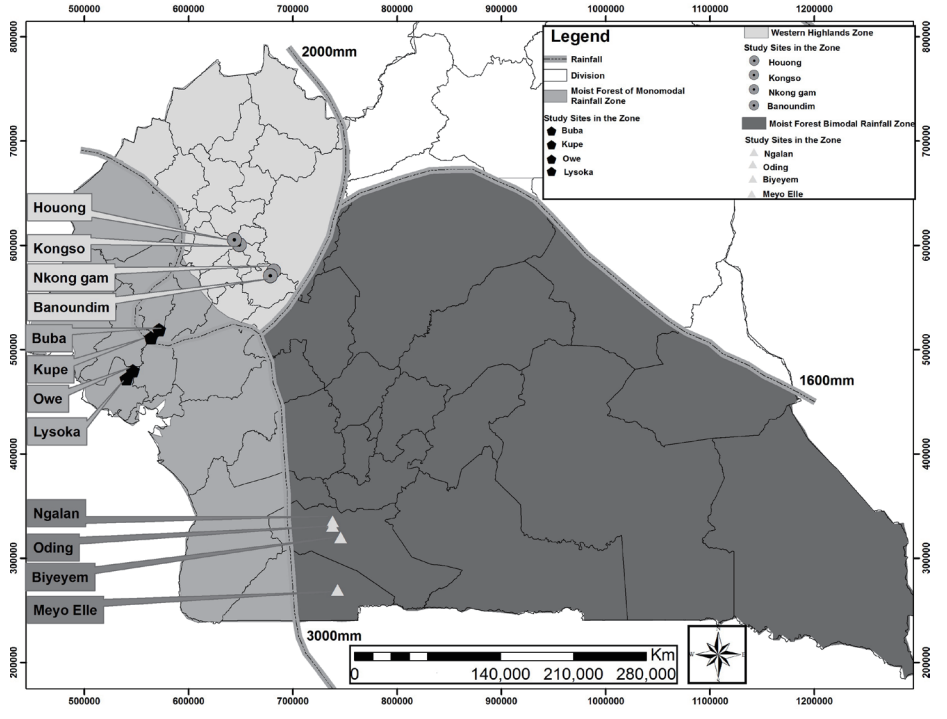

Fig. 1. Sampled villages within study sites of the humid tropics of Cameroon

tural sector is diversified. As such, there is a wide range of crops and livestock ultimately leading to complexities in agricultural conservation practices (IRAD, 2014). Over 60% of the population live in the rural areas and have agriculture as their main activity. Besides a few mechanized industrial operations, agriculture is essentially traditional, comprising of traditional tools and production techniques (Robiglio et al., 2010). With such traditional conditions, work is usually manual and very difficult, cultivated surface area is limited, yields are low and insufficient to meet the domestic and regional demands for food. Geographical reference points were taken for each of these villages, which were later used to locate the villages in a map as shown in Fig. 1 (Tata et al., 2016).

Four villages were selected within each agro ecological zone using the quota sampling approach (Guijt & Woodhill, 2002) conducted at three levels. The villages were grouped into high and low vegetable production zones with two villages selected from each of the observed high or low production threshold trajectories, resulting in a total of four villages per study site. This study followed the qualitative research approach. The authors assumed that farmers and agro-dealers have the capacity to influence and do influence the production and supply of vegetables as well as the use of farm inputs. Based on this assumption, the participatory action research method was used for data gathering and analysis (Chambers, 1994). This approach was chosen to verify and substantiate divergent

ideological positions and the concepts of participation and empowerment as portrayed in the development discourse at the grass root level. Collective research was conducted with field partners in three agro-ecological zones through desk review, meetings, group discussions, key informant interviews, and progressive and reversal framing and reframing of topics. Both primary and secondary data were collected for this study. Secondary data sources consisted of a comprehensive desk review of relevant documents, while primary data were collected through structured interviews. Through the help of the village chiefs and opinion leaders, households in the villages were invited for a study sensitization meeting during which time they were asked to list and rank common vegetables found in the environs by order of importance in terms of abundance, planting, wild harvesting, commercialization, local acquisition from other regions, and consumption. These parameters were rated 1 (low), 2 (moderate), and 3 (high). The average rating of each parameter by community was calculated. After the village meetings, ±15 households were randomly selected per village for interviews using a structured questionnaire. These questionnaires elicited information ranging from family/household profile, household socio-economic characteristics, farming systems and vegetable fields, seed procurement, perceptions in the vegetable sector, and training and extension. A total of 177 farmers were interviewed, with 60 (34%) from Ebolowa, 58 (33%) from Buea, and 59 (34%) from Bafoussam. Seed distributors (farm input wholesalers known as agro-dealers) were identified in all three sites and interviewed for information on the characteristics of vegetable seeds, client inventory, problems encountered in the vegetable seed business, and the farmer's perceptions on seed availability and quality. Agro-dealers were seed importers, more specifically, large scale agro-dealers and the smaller retailers. The smaller retailers had agro shops in the major markets of four areas, the *Mokolo*, *Mfoundi* and *Central* markets in Yaounde, the *Mboppi*, *Rondpoint*, *Sandanga* and *BP Cité* markets in Douala, the Buea town and *Muea* Markets in Buea, and in the *Marché Central* and *Banganté* markets in Bafoussam. A total of 58 wholesalers were interviewed in all the study sites, although no agro-dealer was identified in the Ebolowa area, as all contacted said they did not deal with vegetable seeds. Both the farmer and agro-dealer questionnaires were pre-tested at selected communities in Yaounde. A total of 236 respondents were interviewed as part of this study. Open-ended questionnaires were coded during data entry.

RESULTS

Field discussions revealed that most farmers bought vegetable seeds in Douala, Yaounde, and Bafoussam markets.

I. Socio-Political and Economic Situation in the Study Sites

Vegetable farmers comprised of 51% females and 49% males (Fig. 2). The socioeconomic characteristics of the sampled vegetable farmers in the study sites revealed that more than 80% of the respondents were between the ages of 25

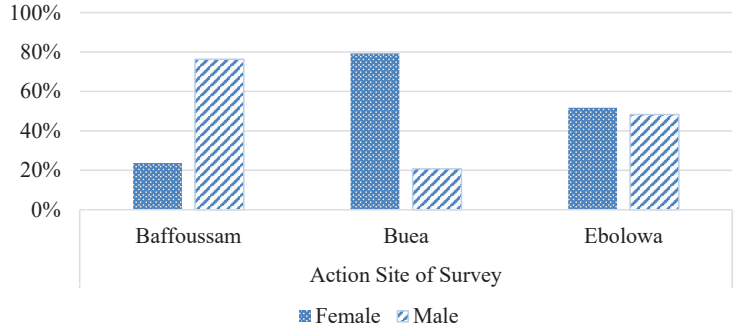

Fig. 2. Distribution of vegetable farmers by gender

and 60, with 81% of households headed by men. Elsewhere, there were female-headed households, whose husband were always absent, and child-headed households who had both parents dead. Of these households, 72% were married with both spouses present, 2% were divorced, 6% had spouses who were always away, 10% were never married, and 10% were widowed. Education completion level among the vegetable farmers was quite impressive: 28% had completed primary school, 23% had dropped out of primary school but could read and write, 20% had incomplete secondary school education, 17% had completed secondary school, and 5% had completed higher education. Only 8% never went to school. This shows that the studied villages had a modest literacy level conducive for agricultural development. This situation was largely the same in most parts of Cameroon (Asongwe et al., 2014).

As shown in Fig. 2, more women were involved in vegetable farming (Kenga et al., 2002) except at Bafoussam. This is also the case in most food crops production activities elsewhere for cereals, legumes and root crops (Fontem et al., 2003; Asongwe et al., 2014). Men were more involved in agriculture especially where it was very lucrative. The situation in Buea and Bafoussam were typical, where women dominated the activity in Buea and men did so in Bafoussam. This reveals two important scenarios for vegetable farming. In Bafoussam, large scale farming of globally important vegetables using imported seeds dominated the smaller scale farming men with taken over the activity. This area has been reported to supply more than 50% of the vegetables sold in Cameroonian markets (Temgoua et al., 2012; Asongwe et al., 2014). The farmers at the Buea site, in contrast, were particularly more engaged in the production of traditional vegetables, and therefore mostly used farmer-produced seeds, traditional tools and farming practices. Women were much more involved in the vegetable production here than men. This shows that as agricultural activities become lucrative, men tend to grasp ownership. At the same time, larger household size discourages selling of vegetables because the farmer place more emphasis on own household consumption needs before selling the surplus (Abia et al., 1997; Omara-Achong et al., 2012).

Distribution of sampled farmers according to years of experience in vegetable production revealed that on the average, the farmers had 14 years of experience. The mean observed farm size was 4.8 ha. Only 10% of the vegetable farmers interviewed had land title ownership which guaranteed the land they were using for vegetable cultivation, while 90% of the farmers used the land they were farming through communal permission or lease.

II. Farmers' Preferences for Different Vegetable Types

From the farmers' questionnaire, an assessment of the occurrence of various vegetables was done, and the authors asked the farmers to list the most common vegetables found and used in their communities. The frequency of citation of each vegetable was calculated. Fig. 3 shows that traditional vegetable species were most preferred as per the observation made by farmers. African nightshade was cited over 120 times as the most preferred vegetable, closely followed by amaranth and hot pepper, then okra, tomato, and bitterleaf.

Other traditional vegetables—okomobong, nkenekene, cassava leaf, wild spinach, cocoyam leaf, bean leaf, and anchia were also cited between 21 and 34 times.

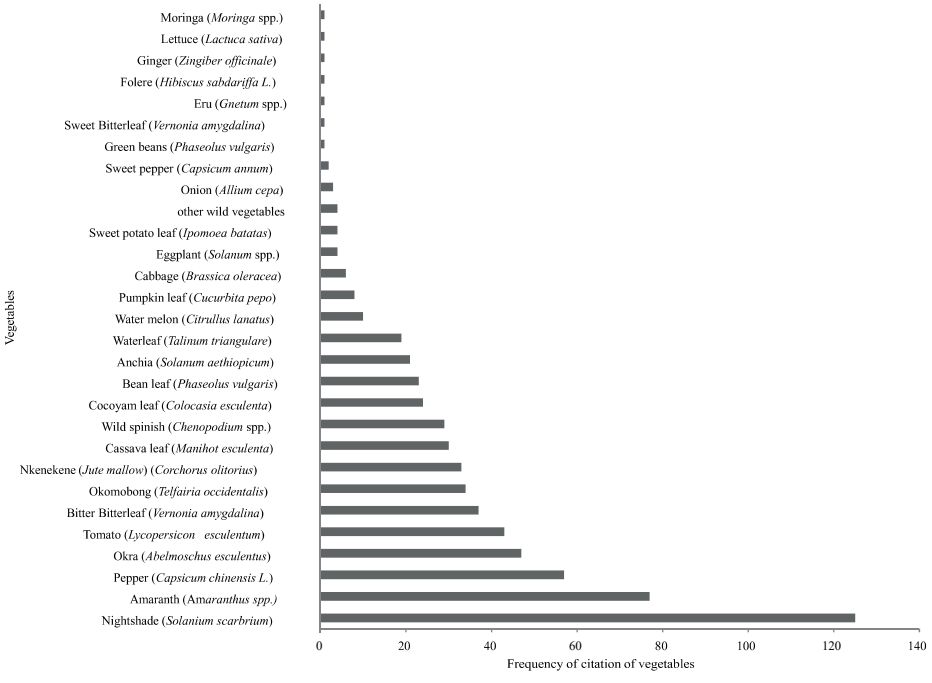

Fig. 3. Ranking of vegetables in order of importance, irrespective of agro-ecological region

III. Commonly Cultivated Vegetables in the Study Sites

The production of vegetable seeds was highly dependent on the demand for vegetables and the overall dietary habits of the local population. People use vegetables depending on the meal, the availability of these vegetables and the occasion for cooking food (Abia et al., 2007; Omara-Achong et al., 2012). The most common vegetable species cultivated in the study sites as noted by respondents are listed in Fig. 4.

As Fig. 4 shows, the most preferred vegetable in all the three study sites was African nightshade—a traditional leafy vegetable. More globally important vegetables including tomato, cabbage, and melon were cultivated in the Bafoussam area, due to higher market demand and return on income as per respondents. In contrast, the Ebolowa and Buea areas remain strongholds for traditional African vegetables due to favourable climate for cultivation and the dietary habits, although there were traces in shifts towards some globally important vegetables, for example, tomato, for income purposes.

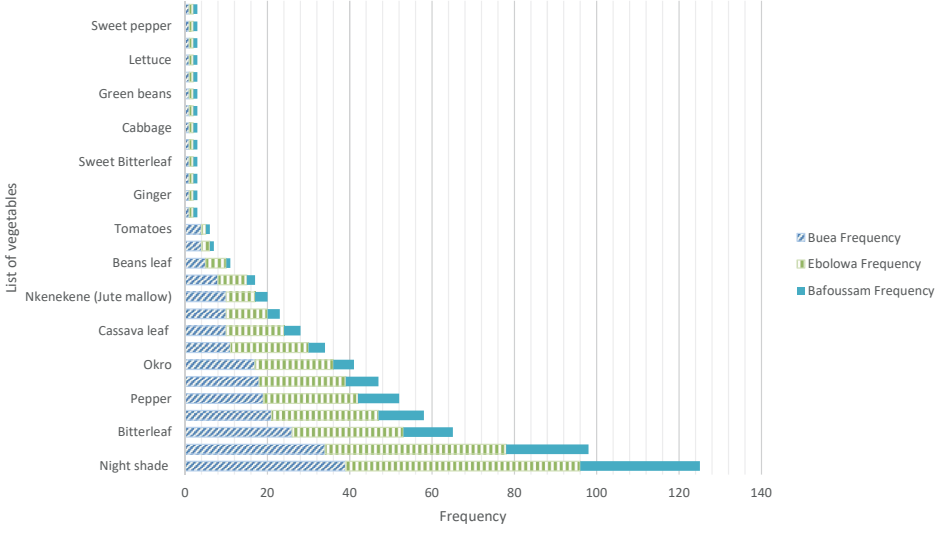

Fig. 4. The most common vegetable species cultivated

IV. Vegetable Farming and Cropping Systems

Vegetable farming and cropping systems were highly varied in all sites. Farmers usually plant vegetables as single crop and/or intercrop them in home gardens and/or distant farms with and/or without the use of chemical fertilizers or pesticides. The vegetable farming and cropping systems observed at the three agro-ecological areas suggest that at the Bafoussam study site, most agricultural households who were initially coffee farmers were found to have shifted to veg-

etable production after the fall in the coffee prices in the early 1990s. Vegetable farming became a large-scale, specialized activity, with not only cultivation in the home gardens for family consumption but also in the distant farms to grow produce for the market. Single cropping was dominant, although all farmers grew few vegetables alongside others, such as maize and beans. Average vegetable farms in Bafoussam, especially for tomato and cabbage, were larger than in the Buea and Ebolowa study sites, some up to 5 ha for a single plot. Vegetable plots were hardly left on fallow at this site due to land scarcity. Consequently, organic fertilizers such as poultry manure, cow dung, compost, and crop residues were used in replenishing the fertility of soils on continuously cropped fields. Organic fertilizer application was usually accompanied by a high use of chemical fertilizer.

In Bafoussam, crop rotation, particularly with cabbage and tomato was common. Unfortunately, the application of pesticides and fungicides was random with enormous fluctuation from one farmer to another. Most field activities such as land preparation, planting and other husbandry practices were done using household labour mostly supplemented with hired labour. In some rare cases, mechanization in the form of plough mounted tractors was used for land preparation in the Bafoussam area. Irrigation was carried out either to supplement rainfall or to sustain crop growth during the dry season. In coffee and other food crop and fruit tree fields, some vegetables were planted in lowland areas around small streams and marshy lands. Harvested produce from such fields was mostly destined for home consumption, but some for income through sales in the market.

In the Buea area, few large scale, specialized vegetable farmers existed. Most of the farmers grew food crops such as cassava, cocoyam, yam, banana, plantain, maize, and sweet potato alongside selected vegetables. Cash crops, mainly cocoa, rubber, oil palm, banana, and sugarcane, were usually intercropped sequentially into existing food crop farms as well as in free spaces within cash crop fields. Some globally important vegetables such as tomato, cabbage, or watermelon were cultivated occasionally as the sole crop. Climbing leafy vegetables were cultivated along fences or around the stems of staple crops, while others such as African nightshade were cultivated around homesteads. Bitterleaf (especially the bitter variety) was cultivated as fence plants. Fallowing was a common practice and shifting cultivation was highly practiced. The use of pesticides and fertilizers were low compared to the Bafoussam study site. This was probably because the dominant soil type here was the rich andosol originating from volcanic activities of Mount Cameroon. Most field operations were done manually, and hired labour was expensive and scarce. The potential for boosting vegetable production at this study site was very high, given relatively very fertile soils, available land, and the favourable agro-climatic conditions.

The situation at the Ebolowa study site was similar to that of Buea. Vegetables were intercropped with food crops such as cassava, plantains, banana, and cocoyam, or industrial crops including cocoa and oil palm. However, the availability of quality vegetable seeds was low, and the use of fertilizer was on the rise due to efforts to produce vegetables to supply the markets. Leguminous cover crops, particularly *Pueraria phaseoloides*, is promoted for soil fertility improve-

ment to replace the long duration fallow rotations of the past. Home gardens were scarce, possibly due to destruction by stray animals. Stray animals range from pigs, to domestic birds and goats, among others.

Labour for field operations in Ebolowa was very scarce. Most of the workers were hired from the Bafoussam study site. Use of wild species of vegetables was common, as much of the area was covered by forest. Wild vegetables such as African nightshade, *Gnetum* spp., and waterleaf were harvested from the forest. The Ebolowa site has a much available land for agriculture. The climatic conditions were favourable for vegetable cultivation. The site is close to neighbouring Gabon, Equatorial Guinea, and the Central Africa Republic. Thus, there awaits a huge market for the products, but the availability of quality vegetable seeds was a major constraint as well as the lack of training on vegetable cultivation.

V. Trends in the Production and Consumption of Some Vegetables per Action Site

The availability and utilization of vegetables was analysed using citations by farmers of individual vegetable varieties mentioned above. Vegetable availability was examined, using abundance as the criteria (i.e., the vegetable was common in the community), through planting (the farmer planted the vegetable), wild harvesting (uncultivated vegetable was obtained from the wild), or importation (the vegetable was mainly from other regions). These categories inform us of the level of domestication and commercial development of specific vegetables in various agro-ecological zones. Simultaneously for the same vegetables, the usage was also examined, whether it was mainly for household consumption or for the market. Fig. 5 presents the trends in vegetable availability and usage per agro-ecological zone. Most wild vegetable varieties were used for home consumption, although small amounts were commercialized.

From the general village meetings, looking at Fig. 5 and Table. 1, vegetable varieties were found to be the most abundant in the Ebolowa site wherein plant-

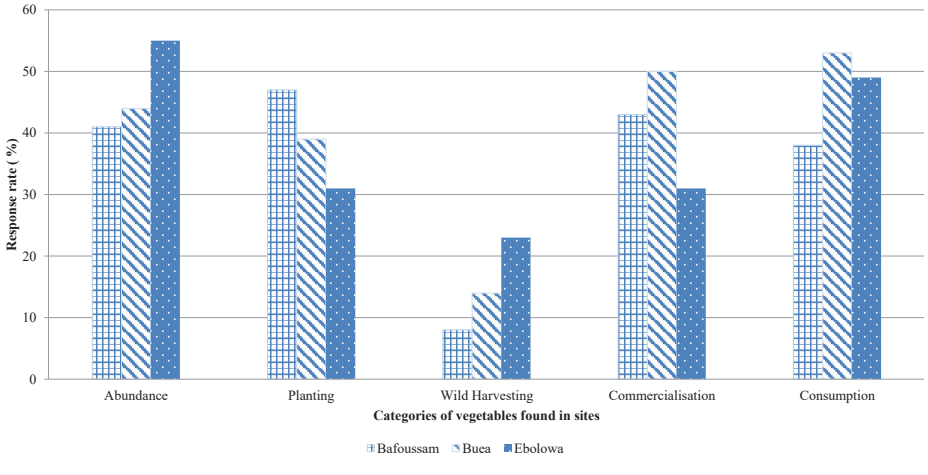

Fig. 5. Trends in vegetable availability and usage in agro-ecological zones

Table 1. Trends in production and consumption of some selected vegetable varieties per agro-ecological zone

Different species of vegetables and sub categories	Buea					
	Abundance	Planting	Wild harvesting	Commercialisation	Import	Consumption
Exotic vegetables	0	1	0	3	3	2
Indegenous vegetable	3	3	3	3	0	3
Huckleberry (African nightshade)	3	3	1	3	3	3
Big leaves	1	3	0	3	2	3
Huckleberry wild	1	1	1	0	1	3
Huckleberry small leaves	1	1	0	1	3	1
Green big leaves	3	3	1	3	3	3
Green wild	1	1	1	1	0	2
Cabbage with flat leaves	2	2	0	1	0	2
Hot pepper yellow/red	1	1	0	3	3	3
Hot pepper elongated	1	0	1	3	3	3
Hot pepper small (bush)	1	0	1	2	0	2
Small leaf bitterleaf (*Vernonia amygdalina*)	3	1	1	3	0	2
Bitter bitterleaf big leaves	3	3	0	3	0	3
Sweet bitterleaf	3	3	1	3	0	3
Waterleaf (*Talinum triangulare*)	3	3	1	3	0	3
Coco leaf (*Colocasia esculenta*)	3	3	1	3	0	3
Telfairia occidentalis	3	3	0	3	0	3
Nkenekene (Jute mallow, *Corchorus olitorius*)	3	2	1	3	0	2
Cassava leaves	3	0	0	1	0	1
Okra	2	2	0	2	2	3

Different species of vegetables and sub categories	Bafoussam					
	Abundance	Planting	Wild harvesting	Commercialisation	Import	Consumption
Exotic vegetables	3	3	0	3	0	2
Indegenous vegetable	3	3	3	3	0	3
Huckleberry (African nightshade)	3	3	1	3		3
Big leaves	3	3	0	3	0	3
Huckleberry wild	1	1	0	1	1	1
Huckleberry small leaves	1	1	1	1	3	1
Green big leaves	3	3	0	3	0	3
Green wild	1	1	1	1	0	2
Cabbage with flat leaves	1	1	1	1	0	2
Hot pepper yellow/red	3	3	0	3	0	1
Hot pepper elongated	3	3	0	3	0	3
Hot pepper small (bush)	2	2	0	3	0	1
Small leaf bitterleaf (*Vernonia amygdalina*)	2	2	1	2	0	1
Bitter bitterleaf big leaves	1	1	0	1	1	1
Sweet bitterleaf	1	2	0	1	1	1
Waterleaf (*Talinum triangulare*)	1	2	0	1	1	1
Coco leaf (*Colocasia esculenta*)	2	3	0	2	0	1
Telfairia occidentalis	1	1	0	1	0	1
Nkenekene (Jute mallow, *Corchorus olitorius*)	2	3	0	3	0	3
Cassava leaves	2	3	0	2	0	2
Okra	2	3	0	2	0	2

Different species of vegetables and sub categories	Ebolowa					
	Abundance	Planting	Wild harvesting	Commercialisation	Import	Consumption
Exotic vegetables	2	0	0	0	3	1
Indegenous vegetable	3	3	3	3	0	3
Huckleberry (African nightshade)	3	3	2	3	0	3
Big leaves	3	1	0	3	0	3
Huckleberry wild	3	3	3	3	0	3
Huckleberry small leaves	1	1	1	1	0	1
Green big leaves	3	2	0	1	0	3
Green wild	3	0	1	0	0	3
Cabbage with flat leaves	2	0	1	0	0	2
Hot pepper yellow/red	1	1	0	1	0	3
Hot pepper elongated	3	2	0	1	0	3
Hot pepper small (bush)	3	2	0	2	0	3
Small leaf bitterleaf (*Vernonia amygdalina*)	3	0	1	1	0	1
Bitter bitterleaf big leaves	2	1	1	1	0	2
Sweet bitterleaf	2	1	2	1	0	1
Waterleaf (*Talinum triangulare*)	3	0	2	1	0	1
Coco leaf (*Colocasia esculenta*)	3	2	1	1	0	3
Telfairia occidentalis	3	1	1	1	0	1
Nkenekene (Jute mallow, *Corchorus olitorius*)	3	2	2	2	0	3
Cassava leaves	3	3	1	3	0	3
Okra	3	3	1	2	0	3

ing was the least and wild harvesting was the highest. Commercialization was minimum in this site and very few vegetables were brought in from other areas. The vegetable types had various varieties as shown in Table 3 following the farmers' description. Farmers had varied preferences for each of these varieties as seen in Fig. 6. Consumption and commercialization was the highest in the Buea area in which globally important vegetables such as tomato and cabbage were brought in and local vegetables were highly commercialized. It is interesting to note that there exists even a local market for vegetables called the Muea market in this locality. Buea came second in high planting activity after Bafoussam, and also second in abundance and wild harvest availability after Ebolowa. The situation was markedly different for African nightshade in the Ebolowa area where it was mostly collected from the wild. In the Buea area, most farmers preferred the narrow leaf African nightshade, because they perceived that it had a better taste, whereas in the Bafoussam study site, respondents mostly preferred the broad leaf type because it grew faster, was less susceptible to pest and disease, and had relatively higher yield.

Farmers had preferences for specific vegetable varieties within the same type of vegetable as shown in Table 1. These preferences were based on the yield of the particular species, the commercial potential of the species, the amount of labour involved in its preparation, and its natural availability on the local landscape. Even within the local varieties, the dietary habits of the local inhabitants guided their preference for some select vegetables in the Ebolowa and the Buea study sites, whereas the commercial value and level of productivity were more important parameters in the Bafoussam study site, explaining the observed varied preferences by the different study sites. In the Ebolowa study site, several species were imported from other neighbouring regions, given the proximity of the border markets. Other preferences noted were the cultivation choice of fast growing species, such as the dwarf okra varieties that have early maturity. Still others preferred the tall varieties of okra although they were late-maturing, because they had a prolonged fruiting period spanning several seasons. The variability in varietal preferences could also be linked to the adaptability to specific agro-climatic zones and/or sites or the taste of the varieties.

VI. Major Problems Linked to Vegetable Farming in Cameroon

The current vegetable farming system in Cameroon faces a multitude of problems. However, following survey data and group discussions with farmers at the Buea, Bafoussam, and Ebolowa areas, the authors identified the most important of these problems, listed in Fig. 6.

The problems linked to vegetable production have been also analysed in Nigeria (Omara-Achong et al., 2012), in swamp zones in urban environs in West Cameroon (Temgoua et al., 2012), in Tanzania (Weinberger & Msuya, 2004), and in Asia (Ali, 2002). All these authors are in synchrony with Sukprakarn et al. (2005), and have reiterated that access to safe vegetable seeds, especially for the indigenous species, was a limiting factor in vegetable production where farmers relied more on their own production of seeds. This study has further confirmed

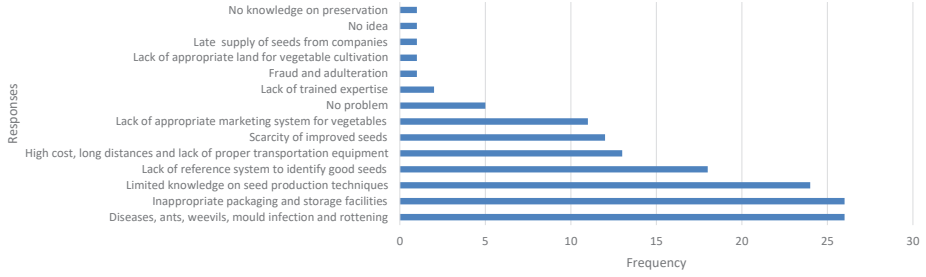

Fig. 6. Problems linked to vegetable seed farming in Cameroon

this trend by demonstrating that besides pests and diseases, farmers highlighted problems of access to seeds as a major constraint in vegetable production. Therefore, the authors had the farmers themselves analyse the farmer perception and demand for vegetable seeds as well as by the agro-dealers or farm inputs wholesalers, through a questionnaire for two common widely used traditional vegetables: a leafy vegetable (African nightshade) and a fruit vegetable (hot pepper).

VII. Farmer Perception and Demand for Vegetable Seeds

As shown in Table 2, the perception and demand for vegetable seeds were analysed for hot pepper and African nightshade using fifteen parameters. The agro-dealers and wholesalers, the distributors had a higher percentage of response (between 54% and 80% of 58 respondents) than farmers (36% and 63% of 177 respondents). The former rated the parameters for hot pepper and African nightshade jointly, since their evaluation was based on the factors influencing the demand for both these products. In their view, high yield was an important parameter that influenced demand, and was always considered by most of the respondents. This was followed by the cost of seed, familiar taste/flavour, previous knowledge about the seed, seed guarantee (germination rate), colour/size of the fruits, and the life span of plant (number of harvesting times/season).

In Table 3, farmers rated more parameters for hot pepper than for African nightshade in assessing their perception about the seeds of fruit and leafy vegetables. This simply means that fruit vegetables had a higher level of standardization than leafy vegetables. As per results, all the respondents perceived high yield as an important criterion for choosing and accepting vegetable seeds. For analytical tractability reasons in the ratings, no particular attention was paid to specific varieties, as the authors emphasized the crops as a single entity without differentiating between varieties.

Table 2. Perception of distributors on vegetable seeds

Perceptions	HY	FT/F	PK	AP	SG/GR	SL	PF	RPD	PC	C/S	C	ISC	PD	L/TR	LSP
Always	12	8	8	6	8	5	7	8	6	8	9	3	3	3	8
Moderate	3	9	8	8	7	8	9	0	9	6	4	9	6	9	3
Never	0	0	0	16	16	16	0	0	0	8	8	0	14	16	5
Not too important	1	2	2	10	3	10	4	4	6	7	7	4	22	14	5
Number of respondents	91	91	87	93	90	92	89	64	90	93	92	63	92	93	73
Percentage of respondents	78	78	75	80	78	79	77	55	78	80	79	54	79	80	63

HY = High yield, FT/F = Familiar taste/flavour, PK = Previous knowledge about the seed, AP = Attractive packaging, SG/GR = Seed guarantee (germination rate), SL = Standard labeling, PF = Presentation to farmers, RPD = Resistance to pests and diseases, PC = Post-harvest characteristics (storage, perishability), C/S = Colour/size of the fruits, C = Cost of the seed, ISC = Information in seed catalogue, PD = Plant display around the shop, L/TR = Labour/technical requirement, LSP = Life span of plant (number of harvesting times/season).

Table 3. Perception of farmers on nightshade and pepper seeds

Perceptions	HY	FT/F	PK	AP	SG/GR	SL	PF	RPD	PD	C/S	C	ISC	ELP	L/TR	LSP
Pepper															
Always	17	9	6	2	11	1	4	12	4	8	7	1	3	3	11
Moderate	3	8	10	6	6	5	8	1	10	7	8	9	5	10	2
Never	0	3	4	22	4	18	5	5	3	3	4	12	10	5	2
Not too important	1	1	0	8	6	17	11	6	7	6	6	10	10	10	2
Number of respondents	111	83	70	73	94	76	72	90	69	77	80	65	65	68	75
Percentage of respondents	63	47	40	41	53	43	41	51	39	44	45	37	37	38	42
Nightshade															
Always	20	9	6	2	12	3	4	9	5	5	7	3	2	3	9
Moderate	1	7	9	5	4	6	8	7	11	8	8	6	7	9	5
Never	0	5	4	20	7	16	5	4	8	6	4	9	7	4	2
Not too important	0	3	7	8	7	10	9	4	7	4	6	9	11	10	2
Number of respondents	107	81	82	75	100	81	70	83	86	70	77	69	64	68	71
Percentage of respondents	60	46	46	42	56	46	40	47	49	40	44	39	36	38	40

HY = High yield, FT/F = Familiar taste/flavour, PK = Previous knowledge about the seed, BP = Attractive packaging, SG/GR = Seed guarantee (germination rate), SL= Standard labelling; PF = Presentation to farmers; RPD = Resistance to pests and diseases, PC = Post-harvest characteristics (storage, perishability), C/S = Color/size of the fruits, C = Cost of the seed, ISC = Information in seed catalogue, PD = Plant display around the shop, L/TR = Labour/technical requirement, LSP = Life span of plant (number of harvesting times/season).

DISCUSSION

The present study examined the situation of vegetable crop farming in three agro-ecological zones of the humid tropics of Cameroon, namely, the western highlands (Bafoussam), the humid forest with mono-modal rainfall (Buea), and the humid forest with bimodal rainfall (Ebolowa). Irrespective of the agro-ecological zone, vegetables were observed in both single and mixed cropping systems, although the field size varied significantly between the Bafoussam area where some farms were as large as 4 ha, while farms in other regions were rarely above 1,000 m^2. Traditional vegetables such as African nightshade (*Solanum scabrum*), bitterleaf (*Vernonia amygdalina*), waterleaf (*Talinum triangulare*), okomobong (*Telfairia occidentalis*), nkenekene (*Corchorus olitorius*) dominated in the Buea and Ebolowa areas. It was observed that there were marked trend shifts in the varieties of vegetables cultivated in the Bafoussam area due to large-scale vegetable farming of globally important varieties (Asongwe et al., 2014; Tata et al., 2014; Abang et al., 2013). The tradition and trend shift also point to the benefit of emphasizing demand creation and promotion with regards to the nutritional importance and diversified income potential of vegetables. There is need to create more vibrant markets for local vegetables. Also since the pressure on land was very high in this study site, the authors observed that vegetable production could be improved mainly by an efficient seed production system, training of farmers, and other vegetable value chain actors. Most of these vegetables were grown all year-round with two to four rotations per plot per year corroborating the observations from other studies (Gockowski & Ndoumbe, 2004; Asongwe et al., 2014; Temgoua et al., 2012; Abang et al., 2013). Most especially in the Bafoussam site, vegetable farming was highly intensive with comparatively high expenditures on labour, irrigation, fertilization, pesticides, mechanization, and input application regimes that were unsustainable or less informed (Abang et al., 2013).

Vegetable farmers were generally young people, and in the larger scale production they were mainly literate and male. This contradicts most studies which suggest that vegetable cropping is mainly a woman's activity (Fontem et al., 2003; Asongwe et al., 2014). However, in the small-scale production in Buea and the Ebolowa sites, more women with a lower literacy rate headed the farms (Kenga et al., 2002). This suggests that once a profitable activity is embraced, men grasp the activity and dominate it (Temgoua et al., 2012).

The distribution of the sampled farmers according to years of experience in vegetable production revealed that on the average, the farmers had 14 years of experience. The mean observed farm size was 4.8 ha, where only 10% of the vegetable farmers interviewed had a land title and guarantee to the land they were using for vegetable cultivation. On the other hand, 90% of the farmers had only the right to use the land they farmed through either communal permission or lease. Land ownership influences agriculture productivity, since farmers feel less motivated to develop and maintain the land not owned by them (Fontem et al., 1999; Fon, 2011). This was a general problem inhibiting the development of smaller holder agriculture in developing countries as demonstrated in the case of

fruit trees in Malawi by German et al. (2009). Furthermore, such farmers may face difficulties in obtaining credit for agricultural purposes due to lack of collaterals since they lack the legal rights to develop the land. This observation is in line with the literature (Weinberger & Msuya, 2004; German et al., 2009; Sukprakarn et al., 2005). The main sources of income for the respondents were agriculture with vegetable sales. Traditional vegetables were most preferred by the farmers for consumption, while global vegetables were more often sold. The formal vegetable seed production sector was not yet interested in dealing with these traditional species, and the seeds of these species available for planting were obtained via the informal sector, where the farmers saved their own seeds or exchanged them with fellow farmers. In such cases, seed performance was poor as occasionally, seeds of several varieties of a species seemed to mix unknowingly. Research should therefore step in to train farmers on improved techniques in seed production, and/or develop improved varieties and disseminate them to targeted farmers. More global vegetables including tomato, cabbage, and melon were cultivated in the Bafoussam area, due to high market demand and return on income as per respondents. The Ebolowa and Buea areas maintain a strong preference for planting traditional African vegetables due to the favourable climate for cultivation and dietary habits. However, there were trace signs indicating trend shifts towards planting more of some globally important vegetables such as tomato for income, thereby requiring outreach emphasis on demand creation via more vibrant markets for local vegetables and promotion with regards to the nutritional importance and diversified income potential of vegetables.

Vegetables were intercropped with food crops such as cassava, plantains, banana, and cocoyams, or industrial crops of cocoa and oil palm in Ebolowa and Buea, whereas in Bafoussam, large fields for single cropping were observed. The authors are of the opinion that the main pre-requisite for success in all three areas was an efficient seed supply and distribution system promotion complemented with increased awareness creation and education on the nutritional importance of vegetables, complemented by training of farmer beneficiaries and other value chain actors.

The results robustly suggest that many vegetables were cultivated in Cameroon with a wide range of uses. Also, each vegetable type has many varieties preferred and used differently, depending on the community. For example, farmers in the Buea and Ebolowa study sites preferred the narrow-leaf varieties of African nightshade while farmers in the Bafoussam study site preferred the broad-leaf varieties. Although the variability in preferences could be linked to the soil adaptability at the sites, since African nightshade is preferred at all three sites, the authors feel it is imperative to carry out adaptability trials before recommending vegetable crop varieties to farmers at different agro-ecological regions. There is therefore the need to emphasize vegetables in nutritional education programs and to promote efforts for increasing its production and consumption in the study and related sites, given that it is one of the micronutrient nutrient-dense traditional African vegetables. Since it is traditionally known and eaten, all that is needed will be value addition through increased demand creation activities, such as developing more cooking recipes to enhance appeal and increase consumption. Hence,

strategies to fight poverty and malnutrition in Cameroon should include the promotion of leafy and fruit vegetables by providing good quality seeds to farmers through variety screening trials.

CONCLUSIONS

General observations found that there was a shift in the varieties of vegetables grown in the Bafoussam study site due to larger scale vegetable farming and poor soils. This has led to the disappearance of the vital traditional species. Thus the microenvironment for this study site is fast changing, giving way to new farming practices, newly cultivated crops, and consequently new culinary trends for the local people. Although the amount of vegetables cultivated were small in comparison to most staples, their extinction or disappearance can result to more global changes that modify the environment and food security of the local people. These would have implications on the national food and nutritional security as well as the need for environmental stewardship, namely, for conservation and maintaining agro-biodiversity.

The ranking of vegetables by farmer preferences demonstrates that traditional vegetables are promising but need to be promoted: African nightshade, amaranth, pepper, okra, bitterleaf, *okomobong*, *nkenekene*, cassava leaf, wild spinach, cocoyam leaf, beans leaf, and *anchia*. Unfortunately, the commercial vegetable seed production sector was not yet interested in dealing with most of these species and thus the seeds of these species available for planting were obtained informally, i.e., the farmers saved or exchanged the seeds). Consequently, the performances of the seeds were observed to be poor, as there were several instances where seeds with occasional varieties of a species were mixed unknowingly. Research should therefore step in to train farmers on improved techniques in seed production and/or develop improved varieties to disseminate to farmers.

Variety screening trials on vegetables brings out the most varieties that adapt to specific environmental conditions (Weinberger & Msuya, 2004; Gockowski & Ndoumbe, 2004; Sukprakarn et al., 2005). The authors believe that it was therefore imperative to carry out adaptability trials linked to the food preferences and commercial potential of the species in order to make recommendations on specific vegetable crop varieties to farmers at different agro ecological zones in the humid tropics.

Great shifts in the dietary habits of the local inhabitants may come to mean that some foods become culturally unacceptable, heralding a problem of food insecurity. Also, it may follow that there will be less food availability to poor households without the means to plant and access new species. This poses an environmental problem, as conservation of agro-biodiversity will be needed if the landscape is greatly altered by replacing local species with globally important species. A likely risk in this circumstance will be the disappearance of the traditional vegetable species more adapted to the environment of the West region of Cameroon. Thus, the authors point to an urgent need to examine the reasons in the disappearance of the traditional vegetable species and to start activities to re-

establish them.

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